

## Rimming flow of a weakly elastic fluid

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### Abstract

© 2014, Springer-Verlag Berlin Heidelberg. We present a theoretical description of the flow of a thin polymeric film on the inner wall of a rotating horizontal cylinder. We account for polymer elasticity with the quasi-linear Oldroyd-B constitutive relation. We apply several simplifications to derive analytical solutions to this otherwise analytically intractable problem. Because the film is thin and the Reynolds number is small, we can implement a lubrication approximation. Furthermore, if we consider weakly elastic polymers, we can expand perturbation series in the limit of a small Deborah number. The analytical approximation for the steady-state free surface shows qualitative agreement with previous numerical simulation. Numerical solutions of the approximate evolution equation demonstrate the destabilizing effect of elasticity on the film's perturbed steady-state profile.

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### Keywords

Approximate model, Rimming flow, Visco-elastic fluid